

# Maximizing Patient Thermoregulation in US Army Forward Surgical Teams

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## INTRODUCTION

The forward surgical team (FST), designed for mobility, provides level II forward life saving and resuscitative surgery. Resuscitative surgery includes controlling hemorrhage from traumatic amputation, as well as damage control surgery, usually an “abbreviated” laparotomy or thoracotomy. The goals of the abbreviated operation are to stop hemorrhage and gastrointestinal soilage.<sup>1</sup> The overall goal of damage control surgery includes avoidance of acidosis, coagulopathy, and hypothermia, also known as the “lethal triad” or “bloody viscous cycle.”<sup>2</sup>

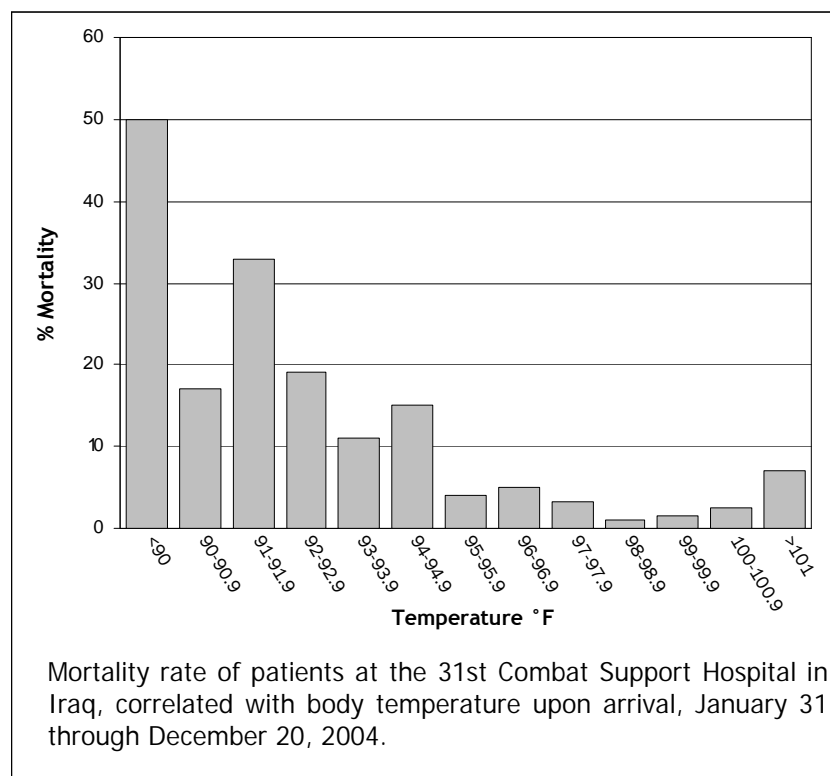
Trauma related hypothermia is defined by body core temperature below 36°C. Hypothermia in trauma and

surgery patients (especially below 34°C) is an independent risk factor and marker of mortality.<sup>3-7</sup> The isolated brain injury patients are the one group that you must be careful rewarming. They should not be rapidly rewarmed above a normal temperature. The major pathophysiologic mechanism associated with trauma and hypothermia related mortality is an exacerbation of coagulopathy and platelet dysfunction, as well as other life threatening complications including infection, electrolyte disturbances, and cardiac dysrhythmias.<sup>8-10</sup> Studies of civilian patients requiring damage control surgery who presented with hypothermia that was subsequently treated with rewarming demonstrated decreased mortality as well as decreased blood and intravenous fluid requirements.<sup>11-13</sup> In a trauma registry of trauma patients

evaluated at a Combat Support Hospital (CSH) during Operation Iraqi Freedom, mortality was also found to be independently associated with admission hypothermia (temperatures below 36°C).<sup>14</sup> That correlation is presented in the Figure.

Patients with admission hypothermia at the CSH in this study also had a significantly higher blood product and factor VIIa requirements. The prevention and correction of hypothermia in damage control patients at FSTs should decrease mortality, as well as the volume of fluid and blood products these patients require. This is especially important in the logistically challenged, austere environment of far-forward combat surgery.

Currently, therapies to prevent and treat hypothermia are not standardized and vary between US Army FSTs and



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between the services (ie, US Navy and US Air Force level II surgical facilities). During the development of a joint theater-wide trauma system, the US military has been challenged to:

1. Define the optimal measures to prevent and treat hypothermia at level II surgical facilities.
2. Provide implementation and universal application of these measures at all level II military surgical facilities.

### OPTIONS FOR PREVENTION OF HEAT LOSS AND THERAPIES TO INCREASE CORE BODY TEMPERATURE

Heat loss with decreases in core body temperature is thought to result from one or a combination of 4 mechanisms:

- Radiation
- Evaporation
- Convection
- Conduction

Primary attention should focus on the *prevention* of heat loss since rewarming patients can be difficult and may require active measures which are invasive and limited in the combat environment. Furthermore, once hypothermia has occurred, patients may be subjected to the self-propagating vortex of the lethal triad—hypothermia causes coagulopathy, which then causes more bleeding, which then results in heat loss, which then causes more coagulopathy, which causes more—and the cycle continues.

Options for preventing heat loss and warming surgical patients involves everything that touches or goes into the patient. Since a significant cause for the loss of body temperature is radiation heat loss, the obvious first area of concern is the ambient temperature in the operating room.

### AMBIENT OPERATING ROOM TEMPERATURE

The summer months in Southwest Asia are very warm, the nights and winter however, especially in the desert environment, can be surprisingly cold. Ambient temperatures lower than 80°F in the operating room are associated with the most common cause of heat loss from radiation. Elevating ambient temperature in the operating room to over 80°F is one of the most important measures to prevent heat loss and decreases

in core body temperature in surgical patients.<sup>15-17</sup> Limitations to this simple maneuver include the inability to adequately heat the operating room. However, environmental control units have demonstrated the capability to effectively heat the operating room and postoperative areas and should be widely deployed with the FST whenever feasible.

### INTRAVENOUS BLOOD AND FLUID WARMERS

Damage control procedures are usually associated with the most critically injured patients. In some cases with documented survival, the resuscitative intravenous fluid requirement has exceeded several liters of crystalloid and up to 40 to 50 units of blood and blood products. These large amounts of refrigerated blood and room temperature fluid can have a dramatic effect on decreasing core body temperature. Infusion devices that warm blood and intravenous (IV) fluid before entering the patient have been documented to prevent heat loss and maintain body core temperature.<sup>18,19</sup> Furthermore, use of rapid infusion systems, in addition to fluid warming, has been documented to decrease fluid and blood requirements, preserve body temperature, and decrease acidosis in hypovolemic trauma patients (optimally after surgical hemostasis).<sup>20</sup> The Belmont FMS-2000® (Belmont Instrument Corporation, 780 Boston Road, Billerica, MA 01821) rapid infusion warming device has demonstrated the capability to adequately warm and infuse rapid amounts of blood and IV fluids.<sup>21</sup>

Currently, warming devices are not universally deployed with the FST. Several field expedient and other novel devices have been used to warm IV fluids. These range from warming water baths to immersing the fluids, utilizing the heating element of a meal-ready-to-eat (MRE), hand warmers, coffee makers, and wrapping IV fluids in heat blankets. The temperature of the fluid may be hard to control with these field expedient methods and could result in overheating, so these methods cannot be universally endorsed.

### CONVECTIVE HEAT BLANKETS

Heating blankets prevent radiation heat loss and actively warm patients by convection, blowing air warmed to 44°C through air columns within the blankets. These systems require electricity and a heating air flow generating unit, as well as disposable

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blankets. The requirements can limit its use in the austere environment. Heating blankets are placed strategically over the patient's body areas that are not undergoing the surgical procedure.

Unfortunately, patients who can benefit the most, polytrauma patients, frequently remain uncovered because several body areas require simultaneous operative intervention to control hemorrhage. The convective heat system most commonly used in military facilities and civilian trauma centers within the United States is the Bair Hugger® Blanket (Arizant Healthcare Inc, 10393 West 70th Street, Eden Prairie, MN 55344) system. Used intraoperatively, convective warming devices have been shown to maintain body temperature and avoid hypothermia.<sup>22-25</sup> Despite the logistical limitations, many FSTs use Bair Huggers in the operating room and postoperative recovery areas. The deployment of Bair Huggers or similar convective warming devices should be universal at all level IIb surgical facilities. Modifications to the device to limit size and weight could be made with minimal industry effort.

Conductive heat loss is another important cause of decreased core body temperature in severely injured patients when these patients are placed on cold stretchers, gurneys, or operating room tables. Simple actions such as the placement of wool blankets, sheets, or other materials that conduct less heat can help minimize heat loss.

Hemorrhagic shock and physiologic derangements result in peripheral vasoconstriction to conserve core body temperature. These homeostatic systems are often overwhelmed in the postoperative resuscitative period, resulting in vasodilation and may allow for further potential body temperature loss. This potential for postoperative heat loss further emphasizes the importance of ambient room temperature, convective heating devices, and the avoidance of conductive heat loss in the immediate postoperative period.

### IRRIGATION FLUID

While it is unusual to use copious irrigation fluid for peritoneal washout during the initial abbreviated laparotomy of damage control, many patients also need irrigation of large soft-tissue wounds. Using ambient temperature irrigation fluid can contribute to



Bair Hugger convection blanket in use in the emergency department

hypothermia, while using irrigation fluid warmed close to normal body temperature can help maintain normothermia.<sup>26,27</sup> There are several potential ways to warm irrigation fluid, including the flameless MRE heaters, microwave ovens, or modification of a convective heater.<sup>28-30</sup> For example, in 2002 a convective Bair Hugger heating hose was used to heat a box of IV and irrigation fluids during deployment to the Afghanistan theater.<sup>31</sup> Several other commercially available heating devices for fluids, such as those produced by Enthemics Medical Systems (W164 N9221 Water Street, Menomonee Falls, WI 53051), are also available. A standard method for warming irrigation and intravenous fluid should be field-tested for universal use by all FSTs.

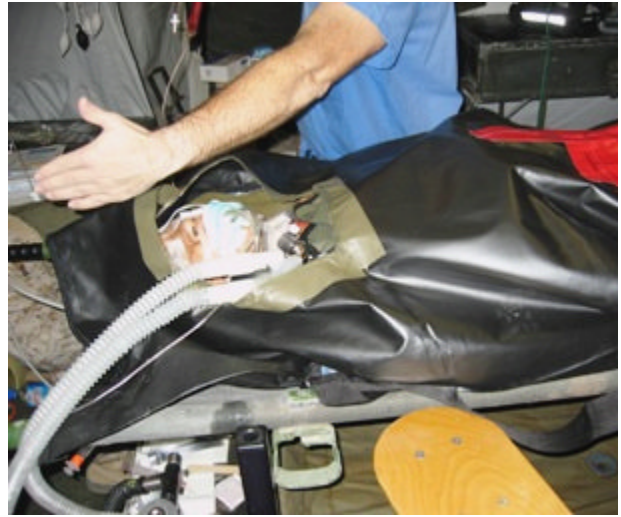
Evaporative heat losses are also important. Patients with open abdomen may experience significant heat losses. The abdomen should be protected with water and airtight barriers, such as, Ioban 2™ (3M, St. Paul, MN 55144-1000) to minimize evaporative heat losses.

## OPTIMAL MEASURES FOR HYPOTHERMIA PREVENTION DURING HELICOPTER EVACUATION

All patients undergoing surgery at the FST or level II facility will be evacuated to the CSH or level III for continuing care and more definitive operative procedures. Intratheater patient movement is usually accomplished by helicopter. Patient movement is associated with environmental exposures, including cooler air at altitude and wind chill.<sup>32</sup> In a study of heat loss during transport in a civilian intensive care unit, patients transported to the radiology department for a computed tomographic scan were found to lose up to 2°C of body temperature.<sup>33</sup> Preventing hypothermia in a postoperative damage control patient in a helicopter is much more challenging than the intrahospital trip to radiology. Air flow through the helicopter should be minimized as much as possible within constraints of security (ie, door gunner). Anecdotal reports indicate that placing the postoperative patient in a “hot pocket” consisting of a modified body bag with 2 wool blankets and a reflective blanket has been used in both Afghanistan and Iraq for retention of body heat. Alternatively, the patient can be placed in a commercially available NARP Hypothermia Prevention and Management Kit™ (HPMK) (North American Rescue Products, Inc, 481 Garlington Road, Suite A, Greenville SC 29615), which includes an active heating element. Some have used the HPMK inside the hot pocket as well. The major limitation of both of these body temperature preservation techniques is that they completely cover the patient, which inhibits patient access and does not allow observation of en route bleeding.

Further evidence to support the technique of multiple layers for transport is that layers of insulating materials have been shown to help decrease loss of body heat in perioperative civilian patients.<sup>34</sup>

While layers of insulating materials decrease loss of body heat, active warming via a convective warming device has been demonstrated to offer optimal prevention of hypothermia in civilian patients



Field expedient “hot pocket”

during transfer.<sup>33</sup> The addition of an active convective heating device (eg, Bair Hugger, Thermal Angel® [Estill Medical Technologies, Inc, 4144 N Central Expressway, Suite 260, Dallas, TX 75204]) and layers of insulating materials may offer the optimal hypothermia prevention to patients undergoing helicopter evacuation. Helicopter safety testing and subsequent fielding of a convective heating system to every helicopter evacuation platform should be considered.

## OPTIMAL ANESTHESIA FOR THERMOREGULATION

General volatile anesthetics (ie, gas anesthetics) further exacerbate hypothermia in trauma patients by

loss of normal thermoregulatory vasoconstriction with resultant vasodilation and redistribution of heat to the skin and peripheral tissues.<sup>35,36</sup> One technique to avoid anesthetic-related hypothermia may be the use of TIVA (total intravenous anesthesia). TIVA, which utilizes intravenous medications such as propofol, ketamine, and fentanyl, with or without a paralytic, may be associated with less peripheral vasodilation and subsequent heat loss.<sup>37,38</sup> TIVA has been used in thousands of civilian patients and has been used by providers in the



Hypothermia Prevention & Management kit



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Iraq theater.<sup>39</sup> One of the authors, LTC Grathwohl, used TIVA anesthesia for combat penetrating neurological injury in over 125 patients, demonstrating the safety and effectiveness of its use in the austere environment.

TIVA should be considered for use in the majority of patients undergoing damage control surgery at FSTs.

### UNIVERSAL LEVEL IIb SUGGESTIONS

Suggestions for consideration for creating universal thermoregulatory measures for Level IIb are listed in the Table. We believe these measures will help decrease the morbidity and mortality of damage control patients, and decrease the logistic requirements for each individual patient.

### FUTURE MEASURES FOR FST THERMOREGULATION

Currently, far-forward deployed ventilators have no ability to heat ventilator gases. Warming of ventilator gases has been documented to help conserve body core temperature.<sup>40</sup> Humidifier moisture exchangers have also been demonstrated to prevent further respiratory related heat loss. Future research and acquisition of these specialized ventilators could help maintain body temperature in the future.

A clear plastic hot pocket with multiple access points would allow patient observation and access en route, similar to the commercially available nuclear, biological, and chemical contamination patient covers. Improvements in convective warming devices, including water-warmed body/bed pads, may represent optimal body warming and replace warm air convective devices in the future.<sup>41</sup> The Arctic Sun is another proprietary device that has demonstrated promise in improving the ability to rapidly warm patients. Some civilian trauma centers are using the fluid rapid infusion device with adaptation to an arterial-venous blood warming device in patients with severe hypothermia. This may have future application in the far-forward surgical platforms and level III surgical facilities.<sup>11</sup>

Looking at long-term advances to provide noninvasive, deep tissue warming using currently unknown technology will provide rapid total body warming to any desired temperature. While, at first

glance, one might conjure images of a science fiction movie, this technology may include advances in microwave heating or other deep radiating heat sources. This could conceivably include regional temperature gradients, for example, providing brain cooling and truncal heating in the multiple system injured patient. While this technology is probably far in the future, the US military should provide leadership in its development.

Recommended Standard Thermoregulatory Equipment for Level IIb Surgical Facilities	
Item	Quantity
Bair Hugger warming unit	4
Bair Hugger convection blanket	20
Belmont FMS-2000 fluid warmer	3
Belmont FMS-2000 tubing	20
Body bags	10
Wool blankets	20
Reflective blankets	10
Environmental Control Unit	2
Enthermic Medical Systems fluid warmer	1
Total Intravenous Anesthesia infusion pump	2

### CONCLUSION

Creating universal minimal thermoregulation standards for all FSTs may decrease morbidity and mortality of combat damage control patients. These standards will also decrease the blood and IV fluid requirements for each individual patient, decreasing the logistical challenges for the FSTs. The importance of maintaining body core temperature in these combat damage control surgery patients cannot be overemphasized.

### REFERENCES

1. Rotondo MF, Bard MR. Damage control surgery for thoracic injuries. *Injury*. 2004;35(7):649-654.
2. De Waele JJ, Vermassen FE. Coagulopathy, hypothermia and acidosis in trauma patients: the rationale for damage control surgery. *Acta Chir Belg*. 2002;102(5):313-316.

3. Asensio JA, McDuffie L, Petrone P, et al. Reliable variables in the exsanguinated patient which indicate damage control and predict outcome. *Am J Surg.* 2001;182(6):743-751.
4. Tyburski JG, Wilson RF, Dente C, Steffes C, Carlin AM. Factors affecting mortality rates in patients with abdominal vascular injuries. *J Trauma.* 2001;50(6):1020-1026.
5. Cushman JG, Feliciano DV, Renz BM, et al. Iliac vessel injury: operative physiology related to outcome. *J Trauma.* 1997;42(6):1033-1040.
6. Hoyt DB, Bulger EM, Knudson MM, et al. Death in the operating room: an analysis of a multicenter experience. *J Trauma.* 1994;37(3):426-432.
7. Janczyk RJ, Howells GA, Bair HA, Huang R, Bendick PJ, Zelenock GB. Hypothermia is an independent predictor of mortality in ruptured abdominal aortic aneurysms. *Vasc Endovasc Surg.* 2004;38(1):37-42.
8. Martini W, Pusateri A, Uscilwicz J, Delgado A, Holcomb J. Independent contributions of hypothermia and acidosis to coagulopathy in swine. *J Trauma.* 2005;58:1002-1010.
9. Cosgriff N, Moore EE, Sauaia A, Kenny-Moynihan M, Burch JM, Galloway B. Predicting life-threatening coagulopathy in the massively transfused trauma patient: hypothermia and acidosis revisited. *J Trauma.* 1997;42(5):857-861.
10. Ferrara A, MacArthur JD, Wright HK, Modlin IM, McMillen MA. Hypothermia and acidosis worsen coagulopathy in the patient requiring massive transfusion. *Am J Surg.* 1990;160(5):515-518.
11. Gentilello LM, Jurkovich GJ, Stark MS, Hassantash SA, O'Keefe GE. Is hypothermia in the victim of major trauma protective or harmful? A randomized, prospective study. *Ann Surg.* 1997;226(4):439-447.
12. Johnson JW, Gracias VH, Schwab CW, et al. Evolution in damage control for exsanguinating penetrating abdominal injury. *J Trauma.* 2001;51(2):261-269.
13. Bernabei AF, Levison MA, Bender JS. The effects of hypothermia and injury severity on blood loss during trauma laparotomy. *J Trauma.* 1992;33(6):835-839.
14. Arthurs Z, Cuadrado D, Beekley A, et al. The impact of hypothermia on trauma care at the 31st Combat Support Hospital. *Am J Surg.* 2006;191(5):610-614.
15. Macario A, Dexter F. What are the most important risk factors for a patient's developing intraoperative hypothermia? *Anesth Analg.* 2002;94(1):215-220.
16. Kean M. A patient temperature audit within a theatre recovery unit. *Br J Nurs.* 2000;9(3):150-156.
17. Closs SJ, Macdonald IA, Hawthorn PJ. Factors affecting perioperative body temperature. *J Adv Nurs.* 1986;11(6):739-744.
18. Smith CE, Desai R, Glorioso V, Cooper A, Pinchak AC, Hagen KF. Preventing hypothermia: convective and intravenous fluid warming versus convective warming alone. *J Clin Anesth.* 1998;10(5):380-385.
19. Smith CE, Gerdes E, Sweda S, et al. Warming intravenous fluids reduces perioperative hypothermia in women undergoing ambulatory gynecological surgery. *Anesth Analg.* 1998;87(1):37-41.
20. Dunham CM, Belzberg H, Lyles R. The rapid infusion system: a superior method for the resuscitation of hypovolemic trauma patients. *Resuscitation.* 1991;21(2-3):207-227.
21. Dubick MA, Brooks DE, Macaitis JM, Bice TG, Moreau AR, Holcomb JB. Evaluation of commercially available fluid-warming devices for use in forward surgical and combat areas. *Mil Med.* 2005;170(1):76-82.
22. Cassey J, Strezov V, Armstrong P, et al. Influence of control variables on mannequin temperature in a paediatric operating theatre. *Paediatr Anaesth.* 2004;14(2):130-134.
23. Kober A, Scheck T, Fulesdi B, et al. Effectiveness of resistive heating compared with passive warming in treating hypothermia associated with minor trauma: a randomized trial. *Mayo Clin Proc.* 2001;76(4):369-375.
24. Patel N, Smith CE, Knapke D, Pinchak AC, Hagen JF. Heat conservation vs convective warming in adults undergoing elective surgery. *Can J Anaesth.* 1997;44(6):669-673.
25. Borms SF, Engelen SL, Himpe DG, Suy MR, Theunissen WJ. Bair Hugger forced-air warming maintains normothermia more effectively than thermolite insulation. *J Clin Anesth.* 1994;6(4):303-307.
26. Moore SS, Green CR, Wang FL, Pandit SK, Hurd WW. The role of irrigation in the development of hypothermia during laparoscopic surgery. *Am J Obstet Gynecol.* 1997;176(3):598-602.
27. Pit MJ, Tegelaar RJ, Venema PL. Isothermic irrigation during transurethral resection of the prostate: effects on perioperative hypothermia, blood loss, resection time and patient satisfaction. *Br J Urol.* 1996;78(1):99-103.

## Maximizing Patient Thermoregulation in US Army Forward Surgical Teams

28. Leaman PL, Martyak GG. Microwave warming of resuscitation fluids. *Ann Emerg Med.* 1985;14(9):876-879.
29. Anshus JS, Endahl GL, Mottley JL. Microwave heating of intravenous fluids. *Am J Emerg Med.* 1985;3(4):316-319.
30. Garcia GD, Modesto VL, Lee KT. Avoiding hypothermia in trauma: use of the flameless heater pack, meal ready to eat, as a field-expedient means of warming crystalloid fluid. *Mil Med.* 2000;165(12):903-904.
31. Craig R, Peoples GE. A novel device developed, tested, and used for warming and maintaining intravenous fluids in a forward surgical team during Operation Enduring Freedom. *Mil Med.* 2006;171(6):500-503.
32. Beekley AC, Watts DM. Combat trauma experience with the United States Army 102nd Forward Surgical Team in Afghanistan. *Am J Surg.* 2004;187(5):652-654.
33. Scheck T, Kober A, Bertalanffy P, et al. Active warming of critically ill trauma patients during intrahospital transfer: a prospective, randomized trial. *Wien Klin Wochenschr.* 2004;116(3):94-97.
34. Brauer A, Perl T, Uyanik Z, English MJ, Weyland W, Braun U. Perioperative thermal insulation: minimal clinically important differences? *Br J Anaesth.* 2004;92(6):836-840.
35. Nebbia SP, Bissonnette B, Sessler DI. Enflurane decreases the threshold for vasoconstriction more than isoflurane or halothane. *Anesth Analg.* 1996;83(3):595-599.
36. Matsukawa T, Sessler DI, Sessler AM, et al. Heat flow and distribution during induction of general anesthesia. *Anesthesiology.* 1995;82:662-673.
37. Shorrab AA, Atallah MM. Total intravenous anaesthesia with ketamine-midazolam versus halothane-nitrous oxide-oxygen anaesthesia for prolonged abdominal surgery. *Eur J Anaesthesiol.* 2003;20(11):925-931.
38. Ikeda T, Kazama T, Sessler DI, et al. Induction of anesthesia with ketamine reduces the magnitude of redistribution hypothermia. *Anesth Analg.* 2001;93:934-938.
39. Matsuki A, Ishihara H, Kotani N, et al. A clinical study of total intravenous anesthesia by using mainly propofol, fentanyl and ketamine with special reference to its safety based on 26,079 cases. *Anesth Resus.* 2002;51(12):1336-1342.
40. Ginsberg S, Solina A, Papp D, et al. A prospective comparison of three heat preservation methods for patients undergoing hypothermic cardiopulmonary bypass. *J Cardiothorac Vasc Anesth.* 2000;14(5):501-505.
41. Janicki PK, Higgins MS, Janssen J, Johnson RF, Beattie C. Comparison of two different temperature maintenance strategies during open abdominal surgery: upper body forced-air warming versus whole body water garment. *Anesthesiology.* 2001;95(4):868-874.

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